

MODIFIED POLYSACCHARIDES HAVING IMPROVED ABSORBENT PROPERTIES AND PROCESS FOR THE PREPARATION THEREOF

This application is a continuation-in-part of U.S. patent application Ser. No. 07/870,529, filed Apr. 17, 1992, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to modified polysaccharides having improved absorbent properties. Specifically, the present invention relates to modified polysaccharides having an improved ability to absorb liquid while under an external pressure and after aging and a process for the preparation thereof.

2. Description of the Related Art

The use of water-swellaable, generally water-insoluble, absorbent materials, commonly known as superabsorbents, in disposable absorbent personal care products is known. Such absorbent materials are generally employed in absorbent products such as diapers, training pants, adult incontinence products, and feminine care products in order to increase the absorbent capacity of such products while reducing their overall bulk. Such absorbent materials are generally present in absorbent products in a fibrous matrix, such as a matrix of wood pulp fluff. A matrix of wood pulp fluff generally has an absorbent capacity of about 6 grams of liquid per gram of fluff. The absorbent materials described above generally have an absorbent capacity of at least about 10, preferably of about 20, and often of up to 100 times their weight in water. Clearly, incorporation of such absorbent materials in personal care products can reduce the overall bulk while increasing the absorbent capacity of such products.

A wide variety of materials have been described for use as absorbent materials in such personal care products. Such materials include natural-based materials such as agar, pectin, gums, carboxyalkyl starch, and carboxyalkyl cellulose, as well as synthetic materials such as polyacrylates, polyacrylamides, and hydrolyzed polyacrylonitrile. While the natural-based, absorbent materials are known for use in personal care products, they have not gained wide usage in such products. The natural-based, absorbent materials have not gained wide usage in personal care products, at least in part, because their absorbent properties are generally inferior compared to the synthetic absorbent materials, such as the polyacrylates. Specifically, many of the natural-based materials tend to form soft, gelatinous masses when swollen with a liquid. When employed in absorbent products, the presence of such soft gelatinous masses tends to prevent the transport of liquid within the fibrous matrix in which the absorbent materials are incorporated. This phenomenon is known as gel-blocking. Once gel-blocking occurs, subsequent insults of liquid cannot be efficiently absorbed by the product, and the product tends to leak. Further, many of the natural-based materials exhibit poor absorption properties, particularly when subjected to external pressures.

In contrast, the synthetic, absorbent materials are often capable of absorbing large quantities of liquid while maintaining a generally stiff, non-mucilaginous character. Accordingly, the synthetic, absorbent materials can be incorporated in absorbent products while minimizing the likelihood of gel-blocking.

Carboxyalkyl cellulose materials and other modified polysaccharides are known in the art. As a general rule, carboxyalkyl cellulose materials are formed from a cellulosic material which has been treated with carboxyalkylating reactants, such as a chloroalkanoic acid, preferably monochloroacetic acid, and an alkali, such as sodium hydroxide, optionally, in the presence of an alcohol. Such a process is described, for example, in U.S. Pat. No. 3,723,413, issued Mar. 27, 1973, to Chatterjee et al. Such carboxyalkyl celluloses are generally water soluble. Various methods of rendering such water-soluble carboxyalkyl celluloses water insoluble are known.

U.S. Pat. No. 2,639,239 issued May 19, 1953, to Elliott describes a process in which a commercially available water-soluble, alkali-metal salt of carboxymethyl cellulose, having a degree of substitution of from about 0.5 to about 1, is subjected to a thermal treatment for up to 10 hours which renders such water-soluble carboxymethyl cellulose capable of forming highly-swollen gel particles.

Similarly, U.S. Pat. No. 3,723,413, discussed above, describes the heat-treatment of a carboxyalkyl cellulose in the presence of remaining carboxyalkylating reactants and by-products, such that, the carboxyalkyl cellulose becomes water insoluble and possessed of desirable liquid absorptive and retentive properties and characteristics.

U.S. Pat. No. 3,345,358 issued Oct. 3, 1967, to Inklaar describes a method of preparing a gel-forming derivative of polysaccharides such as carboxymethyl starch. The method involves acidifying finely divided carboxymethyl ethers of polysaccharides by treating them with acid in methanol or other water-miscible, organic liquid medium. In this manner, acid carboxymethyl groups are formed on the material. The material is held under acidified, non-hydrolyzing conditions to bring about the formation of ester bonds whereby constituent macromolecules of the material become crosslinked one to another. The material is then neutralized with an alkali. The derivatives so produced are described as being capable of forming a gel upon addition to water.

U.S. Pat. No. 3,379,720 issued Apr. 23, 1968, to Reid describes a process of preparing modified polysaccharides, such as ethers and esters of cellulose, comprising slurring a water-soluble polysaccharide in any inert medium, acidifying said polysaccharide, removing excess acid from the acidified polysaccharide, drying same and heat-curing.

U.S. Pat. No. 4,689,408 issued Aug. 25, 1987, to Gelman et al. describes a method of preparing salts of carboxymethyl cellulose. The method involves treating a carboxymethyl cellulose with water, adding a nonsolvent for the carboxymethyl cellulose, and recovering the carboxymethyl cellulose. The carboxymethyl cellulose is said to have an absorbency of at least 25 grams of liquid per gram of carboxymethyl cellulose.

Unfortunately, the known modified polysaccharide materials do not possess absorptive properties comparable to many of the synthetic, highly-absorptive materials. This has prevented widespread use of such carboxyalkyl polysaccharides in absorbent personal care products.

It is desirable to develop and produce a natural-based, highly absorbent material having age-stable absorptive properties similar to the synthetic, highly absorptive materials and, thus, suitable for use in personal care absorbent products.

SUMMARY OF THE INVENTION

The present invention concerns a water-swellaable, water-insoluble carboxyalkyl polysaccharide. The carboxyalkyl